

GEORGIA HYDROWATCH—A NEW CONCEPT IN HYDROLOGIC MONITORING FOR GEORGIA

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Abstract. The U.S. Geological Survey (USGS), Atlanta, Ga., is currently in the process of establishing a statewide real-time hydrologic monitoring network called *Georgia HydroWatch*. In cooperation with numerous Federal, State, and local agencies, the USGS is upgrading many of the existing 143 stream-gaging, coastal, and water-quality stations to include satellite telemetry that relay hydrologic data from the monitoring stations to the USGS office in Atlanta. Combined in this upgrade is the installation of rain gages at as many sites as possible—for better drought monitoring and flood forecasting. To ensure reliable data reception, the USGS has installed a satellite-data receiver station so data are received directly from the satellite at the office; and then automatically entered into the USGS data base and the Georgia District World Wide Web page within minutes of transmission from a gage.

INTRODUCTION

The U.S. Geological Survey (USGS), Atlanta, Ga., is forming the foundation for a statewide real-time hydrologic monitoring network of automated gaging stations—called the *Georgia HydroWatch*. The network will provide continuous real-time river stage, stream-flow (discharge), precipitation, meteorological, and water-quality data to interested parties. These data currently are displayed on the USGS World Wide Web page (<http://www.dgadv.er.usgs.gov/usgs/>); however, new means of disseminating the data will be implemented once the upgrade of the network of stations is completed. The *Georgia HydroWatch* concept was formulated in January 2000, and has quickly received support throughout the State because of its relevance to water-resources issues facing Georgia. This paper includes a general overview of the statewide network, a description of the instrumentation used at the gaging stations, an overview of the satellite transmission process, how the data are disseminated to users, and a discussion of how these real-time data are valuable to many different users.

OVERVIEW OF STATEWIDE NETWORK

As of December 2000, the network of 143 gaging stations operated by the USGS has three levels of telemetry available to relay hydrologic data to the USGS office in Atlanta. *Satellite telemetry* refers to delivery of data via satellite, in four-hour intervals. *Phone telemetry* refers to delivery of data using landline modems that interrogate each station twice daily. *No telemetry* stations require USGS personnel to visit a site on a routine basis and manually retrieve recorded data. The sites displayed as *proposed upgrades* will be upgraded with satellite telemetry and a rain gage during fiscal year 2001. Of these 143 stations, only one currently transmits water-quality data, and only two transmit meteorological data—such as wind speed and wind direction. Precipitation data from rain gages are transmitted from 12 stations statewide. During fiscal year 2001, plans are to instrument at least 22 additional stations to transmit water-quality data, more than 90 additional rain gages statewide, and add a third meteorological station.

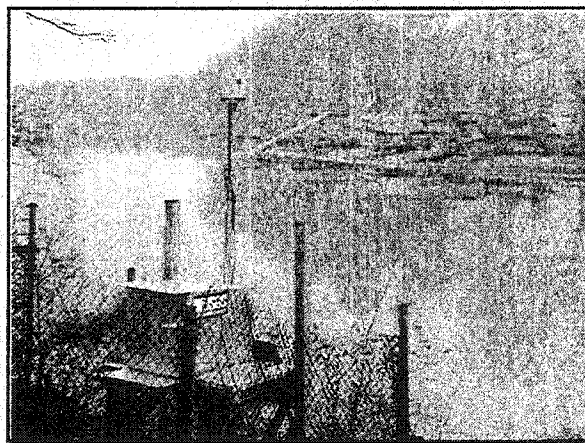


Figure 1. Typical U.S. Geological Survey gaging station.

Prior to January 2000, landline telephone telemetry was the preferred method to relay hydrologic data collected by the USGS, Georgia. When that system was installed in the late 1970's, landline telephone telemetry was state-of-the-art. Compared to today's technology; however, it is obsolete and unreliable. In January 2000, the USGS proposed to convert to satellite telemetry and to install rain gages at every gaging station, with the goal of being 100 percent real-time satellite telemetry within three years. This ambitious goal requires the funding support of numerous cooperating agencies, and a significant investment of time and training. Advantages and benefits of conversion to satellite telemetry include more reliable and timely data collection; reduction of ongoing telephone line service costs; and elimination of outdated instrumentation.

INSTRUMENTATION

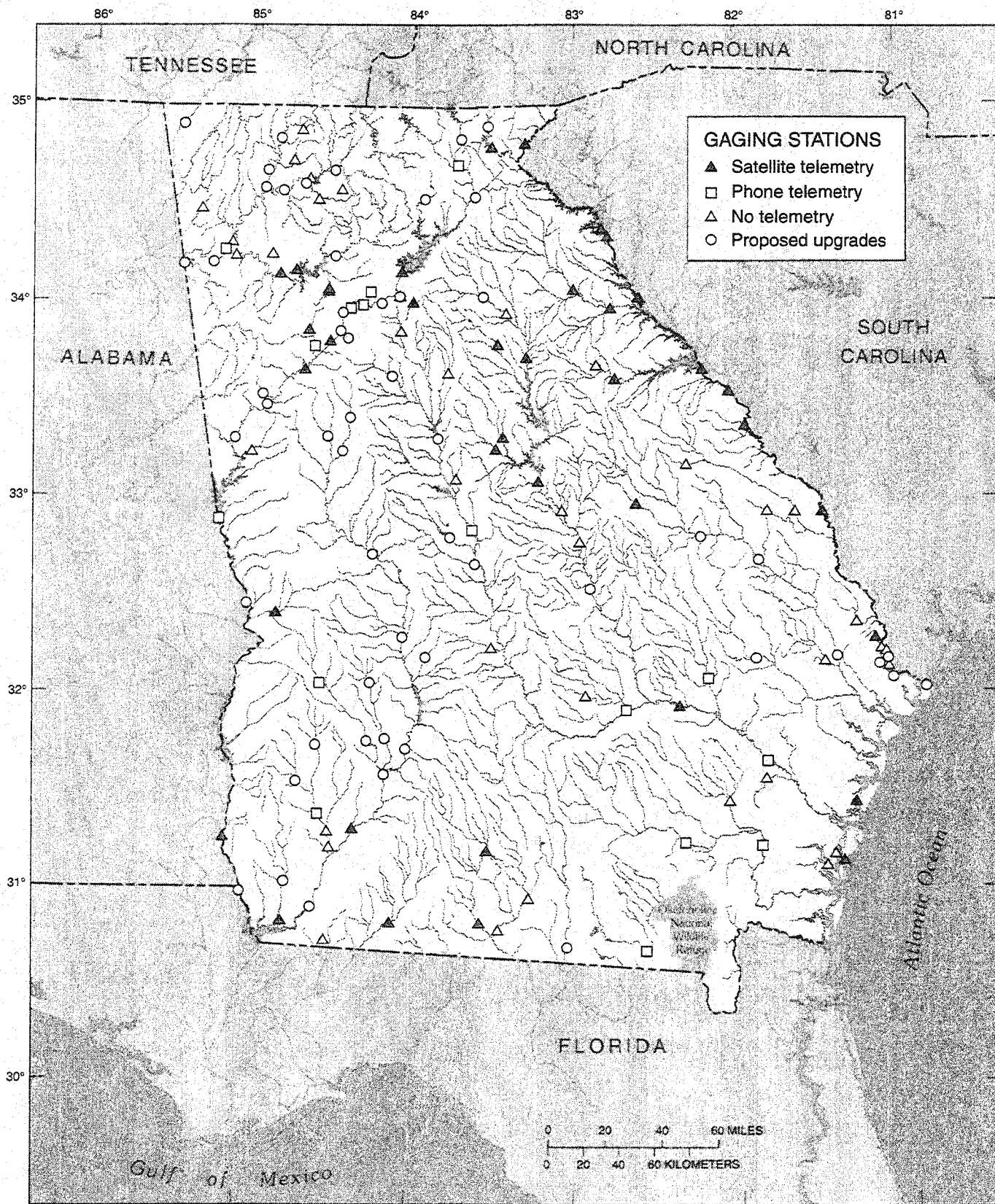
The USGS has developed a standard instrumentation package for the network of gaging stations to better facilitate achievement of the three-year goal. Each gaging station upgrade consists of a commercially available Data Collection Platform (DCP), a water-level sensor, a tipping-bucket rain gage, and an independent power system. The DCP houses a Geostationary Orbiting Earth Satellite (GOES) satellite radio transmitter equipped with a backup data logger. The DCP can accept input from various digital and analog hydrologic sensors, and uses on-board memory to store, manipulate, and transmit data. Typical water-level sensors include a float and pulley system using a digital incremental shaft encoder, submersible electronic pressure transducers, or non-submersible "bubbler" pressure transducers. The tipping-bucket rain gage has a self-calibrating feature that measures the intensity of a rainfall event and compensates for loss of water during the tip of the bucket. The independent power system uses a 20-watt solar panel and rechargeable battery. All instrumentation is housed in a steel or aluminum gage shelter that usually is mounted on the downstream side of a bridge. A typical example of one of these gaging stations is shown in figure 2.

SATELLITE TRANSMISSION PROCESS

Currently, the GOES satellite transmitters use 100-baud rate radios to transmit digital data in a one-minute transmit window once every four hours. Depending upon the quantity of data to be transmitted, a message can be either in ASCII text or in pseudo-binary format. A typical gaging station can easily transmit eight hours of 15-minute stage, rainfall, and battery-voltage data, as well as DCP diagnostic information, within the one-minute window using the ASCII text format. By transmitting eight hours of data, there is a four-hour overlap of *redundant* data in case of an interference problem with the previous transmission. A new system using 300-baud rate radios is proposed to be implemented by 2010 and would allow hourly data-transmission intervals.

In addition to four-hour standard transmission intervals, a DCP can be programmed to use satellite emergency channels to transmit in an instantaneous mode. Pre-set thresholds are programmed into the DCP to trigger this instantaneous mode (for example, stream stage, where the threshold is set to the gaging station's flood stage). The stage sensor is interrogated every 15 minutes, and if that threshold is exceeded, an instantaneous transmission is sent; this process will continue until that threshold is no longer exceeded. The USGS is currently using a combination of four types of instantaneous thresholds: (1) rainfall rate-of-change, (2) stage rate-of-change, (3) water level, and (4) wind speed. The values of these thresholds and the combinations of their use are usually site specific.

A standard transmission is sent from the DCP to the GOES satellite and relayed through a ground receiver station in Wallops, Va.; then re-transmitted to a commercial satellite. From this commercial satellite, the USGS can directly receive the signal. Automated processing software decodes the signal, places the data directly into the USGS data base, and then posts the data to the USGS, Georgia District World Wide Web page within five minutes of arrival of the transmission. The most recent hydrologic data can be transferred "from the stream to your screen" in less than 15 minutes.



Base from U.S. Geological Survey
Digital files

Figure 2. The Georgia HydroWatch network, December 2000.

Currently, the Internet World Wide Web page is the only automatic means of disseminating USGS real-time hydrologic data. Real-time data are considered provisional and subject to change upon final review. The USGS, Georgia District, web page is located at:

<http://ga.water.usgs.gov>.

For a National scope of interest, hydrologic information can be found at USGS web page:

<http://water.usgs.gov>

The USGS is exploring other means of automated data dissemination, including faxes, emails, and voice messages once the gaging-station network upgrade is completed. Other non-automated means of disseminating hydrologic data include the USGS annual data report and data requests to the USGS, Atlanta, Ga.

WHY ESTABLISH THE GEORGIA HYDROWATCH?

The question arises: "Why should the USGS and its cooperators establish the *Georgia HydroWatch* real-time hydrologic monitoring network?" The answer is that with the current public attention of water resources in Georgia, the need for accurate and timely hydrologic information is imperative. The State of Georgia is facing water-resources concerns from both a quantity-of-water and quality-of-water standpoint. The citizens of Georgia also are potentially at risk from natural hazards—such as floods, hurricanes, and drought. Real-time data can be used for various purposes, including flood warning, drought mitigation and response, water-quality emergencies, reservoir operations, saltwater contamination of coastal ground-water supplies, and fisheries habitat monitoring. Water-resource managers need these data to be able to make informed decisions regarding the protection of human and aquatic life, property, and the environment. The USGS Georgia HydroWatch network will be a useful tool for the water-resource managers to help make such decisions.